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An exploratory study of the adaptive anemia hypothesis: Maternal anemia may compromise or enhance breast milk macronutrient levels depending on the type of anemia, the presence of infection, and the milk component

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Background: Maternal anemia has adverse consequences including low birth weight and elevated maternal, perinatal, and child mortality. Recent studies report maternal anemia's association with altered immunological and nutritional components in breast milk. This suggests that compromised breast milk quality may be one pathway linking maternal anemia to child health. To date, no research has investigated this possibility by distinguishing different types of anemia or taking infection/inflammation into account. The present study evaluated the effects of maternal iron-deficiency anemia (IDA), non-iron-deficiency anemia (NIDA), acute infection, and IDA/NIDA accompanying infection on breast milk macronutrients. IDA accompanying infection may represent an adaptive state of activated immune system, inducing the hypoferrmia of infection which limits iron in blood circulation that would otherwise support pathogen growth. In contrast, IDA without infection reflects the deficiency state. These states are hypothesized to have different associations with milk nutrients. **Methods**: A secondary analysis of cross-sectional data and cryogenically archived milk specimens (n=207) was conducted. Regression models for milk nutrients were evaluated for the effects of maternal IDA/NIDA, subclinical infection, and IDA/NIDA-infection interaction. **Results**: After adjusting for covariates, IDA and infection each predicted significantly (p<.05) lower milk fat and non-significantly lower lactose. IDA predicted significantly higher total protein while infection predicted non-significantly lower total protein. A significant IDA-infection interaction was present for milk fat; relative to IDA without infection, IDA with infection predicted higher fat. NIDA predicted significantly higher lactose, non-significantly higher protein, and non-significantly lower fat. There was no significant interaction between NIDA and infection. **Conclusions**: Whether maternal anemia compromises or enhances milk quality may depend on the type of anemia, the presence of infection, and the milk component. Maternal NIDA may enhance lactose. IDA may enhance total protein. IDA may compromise milk fat; however, IDA accompanying infection may enhance milk fat compared to IDA or infection alone. These findings suggest the possibility that some types of anemia among breastfeeding women may have an adaptive function. Results are tentative given the small sample size. Future research should investigate this possibility.
(Limit 500 words)

Keywords: Maternal anemia, iron deficiency anemia, anemia of infection, acute phase response, breast milk quality, lactose, total protein, fat, Creamatocrit; northern Kenya; Ariaal agro-pastoralists